BACKSPOT FACING TOOL

Field of the Invention

[0001] The present invention relates generally to tools to machine the rear face of a component, and more particularly, to a tool which is inserted through an aperture in a workpiece and capable of machining the rear face of the workpiece.

Background of the Invention

[0002] Often, in manufacturing processes, it is required to machine the rear face of a hole.

[0003] Faces requiring machining or deburring located on a front surface of the workpiece may be machined by any suitable tool. However, faces located on the back surface of the workpiece may be more difficult to machine or deburr because of features of the workpiece which do not allow a standard tool to be utilized or it may be inefficient or difficult to position the workpiece to gain access to the back surface. Backspot facing tools, which are inserted through the aperture and are designed to machine a rear face or remove the burr from the back surface are also known in the art .

[0004] One such tool is shown in U.S. Patent 4,710,070, entitled "DEVICE IN BACK SPOT FACING TOOLS", issued December 1, 1987 to Per Alsen et al ("Alsen"). The Alsen tool includes a spindle with a wing arranged in a recess of the spindle. The wing includes a wing edge. The wing is pivotal between an inactive position to an active position. When in the inactive position, the wing is pivoted such that the wing is within the circumference of the spindle. Thus, the spindle and wing may be inserted through an aperture in the workpiece. When the wing is in the active position, at least part of the

wing is located outside the circumference of the spindle. The Alsen tool is designed such that rotation of the tool is one direction acts to move the wing towards the active position and rotation of the tool in the opposite direction acts to move the wing towards the inactive position.

[0005] However, the design of the Alsen tool presents several problems which may prevent the tool from closing. First, particles removed from the workpiece may become trapped or stuck between the wing and the shaft. Furthermore, the force acting on the wing to close the tool is due solely to rotation of the shaft.

[0006] The present invention is aimed at one or more of the problems identified above.

SUMMARY OF THE INVENTION AND ADVANTAGES

[0007] In one aspect of the present invention, a backspot facing tool having a shaft and a cutting element is provided. The shaft has first and second ends and a recess located near the first end. The shaft also has an outer circumference and is centered on a first axis. The cutting element has an inner portion and an outer portion. The cutting element is pivotally coupled to the shaft about a second axis and is movable between a closed position and an open position. The cutting element further includes an inner surface. The inner surface has a negative shear angle with a plane intersected by the first axis.

[0008] In another aspect of the present invention, a backspot facing tool having a shaft and a cutting element is provided. The shaft has first and second ends and a recess located near the first end. The shaft also has an outer circumference and is centered on a first axis. The cutting element has an inner portion and an outer portion. The cutting

element is pivotally coupled to the shaft and is movable between a closed position and an open position. The backspot facing tool is adapted to be rotated in a first direction to remove material from a workpiece. The cutting element is adapted to pivot towards the closed position when the backspot facing tool is rotated in a second direction. The second direction is opposite the first direction. The cutting element exhibits an over-center cam action to initiate movement of the cutting element towards the closed position when the backspot facing tool is rotated in the second direction.

[0009] In still another aspect of the present invention, a backspot facing tool having a shaft and a cutting element is provided. The shaft has a first and second ends and a recess located near the first end. The shaft has an outer circumference and is centered on a first axis. The cutting element has an inner portion and an outer portion. The cutting element is pivotally coupled to the shaft and is movable between a closed position and an open position. The cutting element includes an outer edge and is movable to an intermediate position. The intermediate position is between the open and closed positions. The outer edge inscribes a first circle when the cutting element is in the open position and a second circle when the cutting element is in the intermediate position. The first circle has a smaller diameter than the second circle.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] Other advantages of the present invention will be readily appreciated as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings wherein:

[0011] Fig. 1 is a perspective view of a backspot facing tool and a workpiece, according to an embodiment of the present invention;

[0012] Fig. 2 is a perspective view of the backspot facing tool of Fig. 1;

[0013] Fig. 3A is a line drawing of the backspot facing tool of Fig. 1;

[0014] Fig. 3B is a second line drawing of the backspot facing tool of Fig. 1;

[0015] Fig. 3C is a line drawing of the backspot facing tool, according to another embodiment of the present invention;

[0016] Fig. 4 is an enlarged perspective view of a backspot facing tool, according to an embodiment of the present invention;

[0017] Fig. 5A is a diagrammatic view of a cutting element of the backspot facing tool, according to an embodiment of the present invention;

[0018] Fig. 5B is a diagrammatic view of a cutting element of the backspot facing tool, according to another embodiment of the present invention;

[0019] Fig. 6A is a first top down diagrammatic view of the backspot facing tool of Fig. 1 with the cutting element in an open position;

[0020] Fig. 6B is a second top down diagrammatic view of the backspot facing tool of Fig. 1 with the cutting element in an intermediate position; and,

[0021] Fig. 6C is a diagrammatic view of an enlarged portion of Figure 6B.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[0022] Referring to the Figures, wherein like numerals indicate like or corresponding parts throughout the several views, a backspot facing tool **10** according to an embodiment

of the present invention is shown. The tool **10** includes a shaft **12** and a cutting element **14** pivotally coupled to the shaft **12**.

[0023] The shaft **12** has a first end **16** and a second end **18**. A recess **20** is located near the first end **16**. The shaft **12** has an outer circumference **68** (see Fig. 6A) and is centered on a first axis **22**.

[0024] The cutting element **14** includes an inner portion **24** and an outer portion **26**. The cutting element **14** is pivotally coupled to the shaft **12** about a second axis **28** and is movable between an open position, as shown in Fig. 3A and a closed position, as shown in Fig. 3B. The first and second axes **22, 28** are parallel. In one embodiment, the inner portion **24** and the outer portion **26** of the cutting element **14** are unitarily formed from a compound composed of metal(s) or metalloid(s) and carbon, i.e., a carbide. In another embodiment, the inner portion **24** and the outer portion **26** of the cutting element **14** are removable coupled by one or more fasteners, such as screws, bolts, clips, or any other suitable fasteners. The inner portion **24** and the outer portion **26** may be composed from a carbide or other suitable material.

[0025] The backspot facing tool **10** is adapted to remove burrs from a rear surface **30** of a workpiece, generally shown at **32**. Typically, the burrs are located around an aperture **34** and are formed when the aperture **34** is formed.

[0026] The cutting element **14** includes at least one sharp edge or cutting edge **36** for removing the burrs. The cutting element **14** may be rotated between a closed position and an open position (see below). In use, when the cutting element **14** is in the closed position, the cutting element **14** fits within the outer circumference of the shaft **12** and the

tool **10** may be inserted through the aperture **34**. As discussed, below, when the tool **10** is rotated in a first direction, the cutting element **14** is rotated towards the open position. When the cutting element **14** is in the open position at least a portion of the cutting element **14** extends outside of the circumference of the shaft **12** and the tool **10** may be used to remove burrs from the workpiece **32**. When the cutting element **14** is in the closed position, the cutting element **14** is within an outer circumference of the shaft **12**.

[0027] The shaft **12** is adapted to be coupled to a variety of devices (not shown) which may be used to rotate the tool **10**, such as portable power tools, drill motors, drill presses, automatic equipment, CNC machines, or any other suitable type of equipment.

[0028] With particular reference to Figs. 1, 2 and 5, in one embodiment of the present invention, the cutting element **14** is a back-facing cutting element **14** and has a single cutting edge **36**. In the illustrated embodiment, the cutting edge **36** is perpendicular with the second axis **28**. However, the cutting edge **36** may be at an angle other than 90 degrees with respect to the first axis **24** (see below).

[0029] With particular reference to Figs. 3A, 3B, and 5, in another embodiment of the present invention, the cutting element **14** is a back chamfering cutting element having first and second cutting edges **36A**, **36B**. The first cutting edge **22A** may be used to remove from a front side **26** of the workpiece **18**.

[0030] In one aspect of the present invention, each of the first and second cutting edges **36A**, **36B** forms an angle with a third axis **38**, which perpendicular with the second axis **28**. For example, in one embodiment the first and second cutting edges **22A, 22B** form an angle with the third axis **38** which is less than or equal to 45 degrees. In another

embodiment, the first and second cutting edges **22A**, **22B** form an angle with the third axis **38** which is less than or equal to 30 degrees.

[0031] The cutting element **14** further includes an inner surface **40**. The inner surface **40** defines a plane which includes the second axis **28**. In one aspect of the present invention, the inner surface **40** of the cutting elements has a negative shear angle. With particular reference to Fig. 6A, a plane **42** is defined by the first and second axis **22**, **28**. The shear angle, Φ, is defined by the plane **42** and the inner surface **40**. As stated above, the shear angle is a negative shear angle, i.e., the inner surface **40** is behind the plane **42** when the tool **10** is being rotated in the first direction. In one embodiment, the tool **10** has a negative shear angle of approximately 26 degrees.

[0032] As shown in Fig. 6A, when the tool **10** is rotated in a the first direction, as indicated by arrow **44**, the cutting element **14** is in the open position. The inner surface **40** faces the first direction. By opening up the inner surface **40** in the first direction, it is less likely that material removed from the workpiece **32** will remain between the cutting element **14** and the recess **20**. Thus, the tool **10** will close easier when the shaft **12** is rotated in the second direction.

[0033] The recess **20** includes first and second transverse surfaces **46**, **48**. The first and second transverse surfaces **46**, **48** are generally parallel to each other and perpendicular to the first axis **22**.

[0034] In one embodiment, as shown in Figs. 3A, 3B, and 5, the cutting element has a male end formed by a centering element and a female end formed by a bore (see below). The inner portion **24** of the cutting element **14** includes a centering element **50** located

on a first end **52** of the inner portion **24**. The centering element **50** is received within a first centering bore **54** located within the first transverse surface **46** of the recess **20**. The inner portion **24** of the cutting element **14** includes a second centering bore **56** located in a second end **58**. A retaining screw bore **60** is located at the first end **16** of the shaft 12. In one embodiment, the retaining screw bore **60** receives a retaining screw **62**, which is received within the second centering bore **56**. The retaining screw **62** holds the cutting element **14** in place while allowing the cutting element **14** to pivot about the second axis **28**. A threaded fastener (not shown) may be received by a fastener bore **64**. The fastener bore **64** is transverse the retaining screw bore **60**. The threaded fastener acts to hold the retaining screw **62** in place.

[0035] A cutting element 14 according to another embodiment of the present invention is shown in Figs. 3C and 5B. In Figs. 3C and 5B, in which like-elements are labeled the same, the cutting element 14 has two male ends (see below). The first and second transverse surfaces 46, 48 are generally parallel to each other and perpendicular to the first axis 22. The inner portion 24 of the cutting element 14 includes a first centering element 50' located on the first end 52 of the inner portion 24. The centering element 50 is received within a first centering bore 54 located within the first transverse surface 46 of the recess 20. The inner portion 24 of the cutting element 14 includes a second centering element 56' located on the second end 58. The retaining screw 62' receives the second centering element 56'.

[0036] In another aspect of the present invention, the cutting element **14** is adapted to pivot towards the closed position when the tool **10** is rotated in a second direction (as

shown by arrow **66**). The second direction being opposite the first direction. The cutting element **14** exhibits an over-center cam action to initiate movement of the cutting element **14** towards the closed position when the tool **10** is rotated in the second direction.

[0037] With reference to Figs. 6A-6C, in one embodiment the cutting element **14** includes an outer edge **70**. The cutting element **14** is movable to an intermediate position **72** (shown in dotted lines in Figs. 6B and 6C). The intermediate position **72** is between the open and closed positions. When the cutting element **14** is in the open position and the tool **10** is rotated in the first direction, the outer edge **70** inscribes a first circle **74**. When the cutting element **14** is in the intermediate position **72**, the outer edge **70** inscribes a second circle **76**. As shown, the diameter (D2) of the second circle **76** is larger than the diameter (D1) of the first circle **74**. In use, this arrangement gives the cutting element **14** the over-center cam action. When the tool **10** is first rotated in the second direction, the over-center cam action acts to provide momentum to the cutting element **14** to assist in closing the cutting element **14**, i.e., moving the cutting element **14** towards and into the closed position.

[0038] Other aspects and features of the present invention can be obtained from a study of the drawings, the disclosure, and the appended claims.